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Abstract: We applied ReJeX-iT AG-36 (active ingredient methyl anthranilate) to 14 X 14 m grass plots within a 40 X 120 m enclosure to evaluate its effectiveness as a repellent for Canada geese (Branta canadensis). An application rate of 13 kg/ha reduced ($P = 0.0001$) goose activity on treated grass plots for up to 4 days. We suggest that improvements in the encapsulation process might enhance the effectiveness of ReJeX-iT AG-36.

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Many Canada goose (Branta canadensis) populations in North American are increasing. For example, from 1980 to 1989, numbers in the Mississippi flyway rose from 745,000 to 1,850,000 (a 148% increase) during mid-December surveys (Babcock et al. 1990). While such population increases are important for waterfowl conservation, Canada geese are also implicated in habitat destruction, crop depredation, and nuisance problems (Williams and Bishop 1990). Foraging urban and suburban geese damage grass in parks, backyards, and on golf courses (Laycock 1982). Feces left by geese reduce the aesthetic value and recreational use of these areas and negatively impact water quality and public health (Conover and Chasko 1985, Mott and Timbrook 1988).

Management techniques to reduce nuisance goose problems involve pyrotechnic devices, traps, nest destruction, hunting, and mechanical scare devices (USDA 1986, Aguilera et al. 1991). However, these techniques are limited by cost, logistics, and ineffectiveness. These limitations have stimulated efforts to develop effective, economical, and environmentally safe chemical repellents to deter foraging geese. One such repellent is methyl anthranilate (MA) which is registered with the Food and Drug Administration as a flavor additive for human and animal foods.

Recent evidence suggests that MA may be an effective repellent for grazing waterfowl at concentrations between 1.0% and 2.0% (Cummings et al. 1992). Enclosure tests on 12 Kentucky bluegrass plots showed that a microencapsulation matrix (Encapsulation Technologies, Nyack, New York) of 31%

concentrated MA applied at 9 kg/ha caused geese to avoid treated grass plots for 10 days.

Because the formulations fell short of our expectations, which were repellency for at least 25 days, we felt that additional evaluations of MA encapsulation formulations, concentration levels, and application rates were warranted under simulated field conditions.

The objective of this study was to evaluate the repellency of a new MA product, ReJeX-iT AG-36.

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MATERIALS AND TREATMENT APPLICATION

We obtained ReJeX-iT AG-36, MA concentration of 22.0%, entrapped in a microencapsulation matrix to reduce chemical volatility and photodegradation (PMC Specialties group, Cincinnati, Ohio). In June 1993, 40 adult Canada geese of undetermined sex were cannon-netted (Dill and Thornsberry 1950) on the grounds of the Denver Federal Center, Denver, Colorado in June 1993. Geese were housed in two outdoor pens (8 x 4 x 2 m) with free access to mixed small grains, Purina gamebird chow, and water for an acclimation period of 4 weeks.

We divided a 40 x 120 m grass enclosure at the Denver Federal Center into 6 equal units containing water and shelter and separated by a 2 m woven wire fence. Within each unit, paired 14 x 14 m Kentucky blue grass (Poa pratensis) plots were established (Fig. 1). Grass plots were the only food source for penned geese. Each plot was separated by a 3-6 m buffer zone (bare ground) to

help birds visually distinguish between plots and thus reduce the chance of treatment bias. Plots were watered for 2 hours every 2 days and mowed every 7 days starting day 7 posttreatment.

We sprayed each plot chosen for treatment with ReJeX-iT AG-36 once at 13 kg/ha rate with a boom type sprayer. ReJeX-iT AG-36 was formulated with water and the spraying apparatus was calibrated to deliver 273 L/ha following methods described by O'Neal et al. (1984). We first sprayed control plots at the same application rates with the formulation (minus MA) to prevent any possible contamination from the treated formulation and to provide a direct evaluation of the effect of the active ingredient.

EXPERIMENTAL DESIGN AND DATA ANALYSIS

The basic experimental unit consisted of 2 plots. The unit was used as a blocking factor. One plot within each unit was randomly selected to receive treatment and the other plot served as a control.

Seven days prior to the start of each experiment, 6 geese were randomly selected from the captive population and released into each unit to become acclimated to their surroundings. Each goose had its primary wing feathers trimmed to prevent escape from the enclosure. Geese remained in these units for 19 days after treatment application (posttreatment).

Observations of geese began 6 days before treatment application (pretreatment) on each unit and continued daily until the conclusion of the experiment. Observations consisted of recording the number of geese in each plot at 1-min intervals for 60 min between 0730 and 1030. From an elevated blind which permitted unobstructed views of all plots, we collected data from all plots during a single daily 60-min period (Fig. 1)

To estimate the amount of fecal deposits on each plot, we divided plots into 2 strata of equal width (7 m). Within each strata, we randomly located 2 transects parallel to the center buffer zone. Transects were 50 cm wide and were marked at each end by spikes. Strings attached between spikes delineated transects during fecal deposit collections. Prior to the start of each experiment, the transect and a 1-m swath on either side of the transect were completely cleared of all goose fecal deposits.

Fecal deposits were collected every 2 days from each transect starting 6 days pretreatment and ending at the conclusion of the experiment. Fecal material was immediately transferred to a dryer and dried at 82 C for 24 h and weighed. We converted fecal deposit weights to g/plot for each unit and collection period.

A 250 ml sample of ReJeX-iT AG-36 was collected prior to application to determine MA concentration. The sample was bagged, labeled and stored at 15°C prior to analysis.

We used PROC GLM (SAS Inst. Inc. 1987), to conduct a randomized complete block mixed model analysis of variance with plot and day treated as fixed effects to test treatment differences in bird numbers and goose fecal deposit weights over days. Main effects in the ANOVA were blocks (units), treatment, and day. Where ANOVA results were significant ($P < 0.05$), means were separated using Duncan's Multiple Range Test (Neter et al. 1985).

RESULTS

There was a significant treatment by day interaction ($F_{17,85} = 4.87$, $P = 0.0001$) in bird numbers. There were no differences ($P > 0.05$) in the numbers of geese on the treated and control plots pre-treatment. Following treatment, fewer geese were observed feeding on treated plots than on the control plots

up to day 4 (Fig. 2), but only days 1 through 3 showed significant differences ($F_{17,85} = 4.87$, $P = 0.0001$).

For fecal deposits, the treatment by day interaction was significant ($F_{8,40} = 4.57$, $P = 0.0005$). There were no differences ($P \geq 0.05$) in fecal deposits on the treated and control plots pretreatment. Following treatment, fewer ($F_{8,40}$, $P = 0.0005$) fecal deposits were collected on the treated plots than on the control plots up to 4 days posttreatment (Fig. 2).

DISCUSSION

ReJeX-iT AG-36 showed limited effectiveness to reduce Canada goose activity on treated grass plots. Even during the period when goose activity was reduced, geese continued to sample treated grass. The active ingredient in ReJeX-iT AG-36, methyl anthranilate, is considered to be a chemosensory repellent acting through taste, olfaction, and the common chemical sense (Mason et al. 1989). It has no aversive postingestional effect that might cause food avoidance learning. In our experiment, geese continued to sample treated grass and as ReJeX-iT AG-36 concentrations degraded below the repellency threshold, foraging activity resumed. It is possible that the thin-walled encapsulation matrix was damaged during application, causing rapid and substantial release of methyl anthranilate. Environmental factors, such as ultra-violet light and rainfall are not considered factors since the formulation contains a UV protector and treated plots received no measurable moisture (rain or irrigation) until 7 days posttreatment. We suggest that improvements in the encapsulation process might enhance the effectiveness of ReJeX-iT AG-36. A pressure release capsule would have the advantage of being broken before release of the chemical would occur and would prolong the treatment.

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Figure Captions:

Fig. 1 Waterfowl testing enclosure divided into 6 units. Each unit was divided into 2 14 x 14 m grass plots.

Fig. 2 Total number of Canada geese and fecal deposits on grass plots treated with Rejex-it AG-36 at an application rate of 13 kg/ha, Denver, Colorado. TX notes treatment day.



